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area $MNP = \frac{1}{2}MN \times HK = \frac{1}{2}ry(\cos\varphi - \cos\theta) = u$, when $\varphi < \theta$,
" " " $= \frac{1}{2}ry(\cos\theta - \cos\varphi) = u_1$, when $\varphi > \theta$.

The limits of θ are 0 and $\frac{1}{2}\pi$; of φ, 0 and θ, and θ and π; of x, 0 and $2r\sin\theta = x'$; and of y, 0 and x. Therefore the required average is

$$\frac{\int_0^{\frac{1}{2}\pi}\left\{\int_0^{\theta}2ur^2\sin^2\varphi d\varphi + \int_{\theta}^{\pi}2u_1r^2\sin^2\varphi d\varphi\right\}\int_0^{x'}\int_0^{x}r\sin\theta\, d\theta dx dy}{\int_0^{\frac{1}{2}\pi}\int_0^{\pi}\int_0^{x'}\int_0^{x}r\sin\theta . 2r^2\sin^2\varphi\, d\varphi dx dy}$$

$$= \frac{3}{2\pi r}\int_0^{\frac{1}{2}\pi}\left\{\int_0^{\theta}(\cos\varphi - \cos\theta)\sin^2\varphi d\varphi \right.$$

$$\left. + \int_{\theta}^{\pi}(\cos\theta - \cos\varphi)\sin^2\varphi d\varphi\right\}\int_0^{x'}\int_0^{x}\sin\theta d\theta dx dy$$

$$= \frac{2r^2}{\pi}\int_0^{\frac{1}{2}\pi}\left\{\int_0^{\theta}(\cos\varphi - \cos\theta)\sin^2\varphi d\varphi + \int_{\theta}^{\pi}(\cos\theta - \cos\varphi)\sin^2\varphi\, d\varphi\right\}$$
$$\times \sin^4\theta d\theta$$

$$= \frac{r^2}{3\pi}\int_0^{\frac{1}{2}\pi}\Big[3(\pi - 2\theta)\cos\theta + 4\sin\theta + 2\sin\theta\cos^2\theta\Big]\sin^4\theta d\theta = \frac{512r^2}{525\pi}.$$

436. No solution received.

NOTE BY W. E. HEAL.—The values of A, B, C, &c., given by me at page 56 (ANALYST, No. 2) should be

$A = b^8[a^4 - (a^2+b^2)x^2]^2\tan^2\varphi - 4a^4b^{10}x^2 + 4a^2b^{10}x^4$.

$B = 4[a^2b^6(a^2+b^2)^2x^3\lambda - a^6b^6(a^2+b^2)x\lambda]\tan^2\varphi - 8a^6b^8x\lambda + 16a^4b^8x^3\lambda$.

$C = [2a^8b^8 - 2a^4b^4(a^2+b^2)(a^4\lambda^2+b^4x^2) + 6a^4b^4(a^2+b^2)^2x^2\lambda^2]\tan^2\varphi$
$- 4(a^8b^6\lambda^2 + a^6b^8x^2) + 24a^6b^6x^2\lambda^2$.

$D = 4[a^6b^2(a^2+b^2)^2x\lambda^3 - a^6b^6(a^2+b^2)x\lambda]\tan^2\varphi - 8a^8b^6x\lambda + 16a^8b^4x\lambda^3$.

$E = a^8[b^4 - (a^2+b^2)\lambda^2]^2\tan^2\varphi - 4a^{10}b^4\lambda^2 + 4a^{10}b^2\lambda^4$.

Also in lines 2 and 9 of same page "a^2y" should be a^2y^2.

PROBLEMS.

437. *By Prof. Casey.*—AE, AK are two indefinite given straight lines, C and H given points in them, and P a given point in their plane. Req'd to draw through P two straight lines, PB, PD, intersecting AE and AK in R and S, respectively, and containing a given angle RPS, so that $RC \times SH$ may be equal to a given magnitude.

438. *By Prof. F. H. Loud.*—Two equiangular parallelograms, $OACB$ and $OA'C'B'$ are so placed that the equal angles AOB and $A'OB'$ coincide. The sides of the former figure are constant, those of the latter are variable, subject to the condition $A'O+OB' : AO+OB ::$ *area* $OA'C'B'$: *area* $OACB$. $A'C'$ meets BC in D, and $B'C'$ meets AC in E. Show that DE passes through a fixed point, and determine the point.

439. *By Prof. Nicholson.*—Solve geometrically the following:

On a line whose length is a are two points x distance apart; what is the average value of x?

440 *Selected.*—A lamina is bounded on two sides by two similar ellipses, the ratio of the axes in each being m, and on the other two sides by two similar hyperbolas, the ratio of the axes in each being n. These four curves have their principal diameters along the coordinate axes. Prove that the product of inertia about the coordinate axes is

$$\frac{(\alpha^2-\alpha'^2)\,(\beta^2-\beta'^2)}{4(m^2+n^2)}$$

where $\alpha\alpha'$, $\beta\beta'$ are the semi-major axes of the curves. (Routh's Rigid Dynamics.)

PUBLICATIONS RECEIVED.

Celestial Charts, made at the Litchfield Observatory of Hamilton College, Clinton, N. Y., by C. H. F. PETERS. Nos. 1–20. Each chart covering 20 min. in right ascension and 5° in declination.

The whole of the work involved in the production of this very valable series of charts, including the cost of publication, has been at the author's expense for gratuitous distribution.

Studies in Logic, by Members of the Johns Hopkins University. 203 pp. 12mo. Boston: Little, Brown, and Company. 1883.

Scientific Proceedings of the Ohio Mechanics' Institute. No. 1 of Vol. II., March, 1883. Cincinnati, Ohio.

An Extension of the Theorem of the Virial, and its Application to the Kinetic Theory of Gases. By H. T. EDDY C. E., PH. D. [From the Scientific Proceedings of the Ohio Mechanics' Institute for March, 1883.]

Report on the Michigan Forest Fires of 1881. [*Signal Service Notes, No. I.*] Office of Chief Signal Officer. Washington. 1882.

ERRATA.

On page 74, line 4, for "1076.4", read ± 1076.4.
" " 75, lines 12 and 13 from bottom, *dele* parethesis before "in" and after "positive".
" " 85, line 12, for "2", read 1.